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'Probeware' on Increase In Schools' Science Labs

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Abstract

Although the term "probeware" may not be a household word, it has grown more familiar to science educators over the past decade, as companies have marketed a new generation of high-tech instruments for collecting and analyzing data from the physical world.

Full Text

Turning students into apprentice scientists has long been a goal of K-12 science educators. But it's been many years since real scientists used the paper logs, alcohol thermometers, balances, stopwatches, meter sticks, and other gear that remain staples of many high school science labs.

And that's where "probeware" comes in.

Though the term may not be a household word, it has grown more familiar to science educators over the past decade, as companies have marketed a new generation of high-tech instruments for collecting and analyzing data from the physical world.

Today, those tools include digital scientific probes or sensors that collect data on temperature, motion, gas pressure, light, and other characteristics. Other devices called "data loggers"--either hand-held computers or interface boxes attached to computers--compile the data from probes, display them in real time, and transfer them to software that can analyze and present the information in various ways. Collectively, this gear, and the computer software with which it is integrated, is called "probeware."

For some school officials, finding room in the budget for specialized scientific tools such as probeware is not a high priority.

Still, school technology officials surveyed for "America's Digital Schools 2006"--a report by two market-research firms, the Hayes Connection Inc., based in Denver, and the Greaves Group LLC, in Encinitas, Calif.--said they expected to increase their annual purchases of probeware from less than \$1 per student to an average of \$2.34 per student by 2011.

Some experts say those plans reflect greater confidence in the educational value of probeware. "A data collector is a doorway to understanding for students; it allows them to see real-time data so that can actually remember it," said Carolyn Staudt, one of several researchers at the Concord Consortium, a nonprofit educational research group, who have studied the use of probeware in schools for more than six years.

Yet teachers have only slowly gained access to probeware and facility in using it. "It's the top 3 or 4 percent of teachers that really use probeware," Ms. Staudt said. "A lot of schools have a little bit of this, a little bit of that. It's thrown into back drawers."

Greater Simplicity

A decade ago, the probeware marketed to high schools was in the form of products that had generally been adapted from scientific tools used at the university and professional level, several experts said. And the equipment was often complex to operate.

Over time, though, the companies realized that the equipment needed to become much simpler and more intuitive to appeal to K-12 teachers. Probeware is now developed and marketed specifically for schools, in a niche of the educational technology market that currently is shared by five main players: Data Harvest Educational Inc., Fourier Systems Inc., PASCO Scientific Inc., Texas Instruments Inc., and Vernier Software & Technology Inc. Based on a national survey of 875 school officials, "America's Digital Schools 2006" projected that spending plans for science probeware would rise from \$54 million in 2006 to nearly \$131 million in 2011.

One teacher who has made the switch to the new tools is Raymond L. Barber, a 9th grade science teacher in the Chico Unified School District in California. He has digital probes connected to the Universal Lab Interface 2, by Vernier, one of the largest companies in the small world of probeware manufacturers. The interfaces are connected to computers in his science lab, or to graphing calculators.

Recently, Mr. Barber said in an interview, his students at Pleasant Valley High School, in Chico, used electronic gas-pressure sensors to measure the pressure changes of ordinary atmospheric gas in sealed laboratory flasks as they were heated and cooled in baths of water.

The voltage of the electrical current running between the sensors and the interfaces changed as the pressure changed. The interface then reported those data to the computers, which presented them as graphs showing the changes over time.

The graphs made clear to his students, Mr. Barber said, that "as you increase the temperature of the gas inside, the molecules gain kinetic energy and put great pressure on the inside of the container." Or, in other words, "there's a reason you just don't want to throw an aerosol can into a fire."

Last year, the Concord Consortium completed the second of two three-year studies, financed by the National Science Foundation, on the use of probeware in school science instruction. The two studies, which used random assignment of teachers, were conducted in grades 3-8 in a variety of disciplines, including physical science, life science, technology, and engineering.

The studies tested all available brands of school probeware, without distinguishing among manufacturers. They used the equipment with both hand-held and desktop computers, though with a common software interface developed by the consortium.

In the first study, conducted from 2001 to 2004, students who used probeware scored significantly higher on pre- and post-tests in science compared with students who did not use probeware, Ms. Staudt said. The second study, from 2004 to 2007, met a higher research standard, "as close to the medical model as we could have, with validated results," and also showed that students learned more using probeware, she said.

Influence of STEM Push

Educators and company officials also attribute a recent surge in interest in probeware to a push to blend together instruction in the so-called STEM fields of science, technology, engineering, and mathematics in an applied context, an approach that business and political leaders have been talking up as a key to the nation's future economic competitiveness.

The 120,000-student Hillsborough County, Fla., school district recently ordered data loggers and probes from Data Harvest Educational, a U.K. company with a U.S. distribution center in Buffalo, N.Y. Under a grant from a local foundation, two of the probeware devices will be given to 15 of the 45 middle schools in the district, said Pamela A. Caffery, the district's resource teacher for middle school science.

"We know that middle school students who are excited about science have a tendency to go further in science exploration and go to higher levels of science education," she said.

The grant is also paying for Ms. Caffery to train teachers in how to use the probeware in their lessons. If the teachers find the devices useful, she said, the hope is that the schools will use their own budgets to buy more of them.

Ms. Caffery was about to leave for the National Science Teachers Association's annual conference, to be held March 27-30 in Boston, which attracts thousands of science teachers, and companies that sell equipment and materials for science instruction.

With the exception of Data Harvest Educational, all of the probeware companies are scheduled to be at the conference, hosting workshops and presentations.

Product Rollouts

Data Harvest has tried to penetrate the market for probeware in U.S. elementary and middle schools with its Q5 data logger, said Craig Ecclestone, the president of the company's North American division. The company sells the device, which has five built-in sensors, plus add-on motion and heart-rate sensors, for \$500.

PASCO Scientific, based in Roseville, Calif., will unveil its latest probeware device, the Spark Science Learning System, which is aimed at simplifying the use of probeware, said Wayne Grant, its chief education officer.

Designed for use from elementary through high school, the Spark has a screen and specialized cartridges for plugging in probes for different kinds of scientific-data collection. The screen can present data as numbers and graphs, and can be stocked with curriculum content that students and teachers can read to help them interpret the data they are collecting. The mobile, dual-handled gadget will be shipped by next fall, and can be

preordered for \$299 apiece.

"For teachers that do not have a strong background in science, we have the ability to place content, not just for instruction on what to do, but background material, on the screen," said Mr. Grant. "You might imagine this as a live electronic textbook, with access to images and graphics they might see in the textbook, but, in addition, live data."

Texas Instruments, which dominates the school market for calculators, is involved in probeware in two ways. Its calculators are compatible with Vernier probes and devices. But TI also has its own probeware data-collection tools that can be linked to its TI Navigator system, a classroom network setup.

Daniel R. Gremillion, who is the product-strategy manager for the education technology business of the Dallas-based semiconductor company, said that it promotes the use of probes with calculators in some of the professional-development classes that it presents to more than 56,000 teachers a year.

Fourier Systems, an Israeli company with U.S. headquarters in New Albany, Ind., has distinguished its offering for K-12 by combining, in one device, a basic, low-cost laptop computer--the Nova 5000--that provides access to office software and the Web as well as attachable probes for data collection.

Brenda Raker, the company's chief executive officer of U.S. operations, said Fourier's U.S. customer list is growing. Recent activity, she said, includes a contract with West Virginia to provide the \$499 devices to 60 high schools, and a sale of 400 to the San Antonio schools. Like other probeware vendors, Ms. Raker said she seen an uptick in inquiries lately from school districts looking for technology to enhance their curricula in STEM.

One of the leading probeware companies, Vernier Software & Technology, based in Beaverton, Ore., has garnered loyal fans among teachers. Several said CEO Dave Vernier, a former physics teacher, often picks up the phone when they call with questions. The company sells its hand-held LabQuest probe interface for \$329.

"We don't pretend to replace textbooks," Mr. Vernier said. "All we're trying to do is provide the laboratory element, which can be the most interesting and fun part of the science classroom." Coverage of mathematics, science, and technology education is supported by a grant from the Ewing Marion Kauffman Foundation at www.kauffman.org.

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